

Reconstructing *Palorchestes* (Marsupialia: Palorchestidae) - from Giant Kangaroo to Marsupial 'Tapir'

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Since their initial description in 1873, palorchestid marsupials have been reconstructed in a variety of ways ranging from giant kangaroos, long-necked llama like-forms, bizarre okapians to their present popular image as quadrupedal marsupial 'tapirs'. These reconstructions have resulted from an improved understanding of the phylogenetic position of *Palorchestes*, more complete fossil material and even the interpolation of supposed Australian Aboriginal renderings of these animals in Arnhem Land rock art. An examination of the timing of these different 'views' of *Palorchestes* has revealed that historical and social factors have also influenced how this animal has been visualized.

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INTRODUCTION

Attempts by vertebrate palaeontologists to reconstruct fossil animals are almost as old as the science that has informed such endeavours. In nineteenth century Europe, the French anatomist, Baron Georges Cuvier, gained a public reputation of being able to complete a "restoration from a single fossil fragment of complete skeletons of creatures long since extinct" (Owen 1894:398). It appears, however, that Cuvier had only a marginal interest in attempting such reconstructions, dismissing them as too speculative (Coleman 1964, Outram 1984). Indeed, Cuvier didn't publish any full reconstructions of prehistoric animals due primarily to his concern that such drawings would impact on his reputation as a scientist (Rudwick 1992). Across the channel, the so-called 'British Cuvier', Sir Richard Owen, earned similar accolades for his ability to reconstruct extinct animals from the most meager of remains. In one instance, Owen was said to have deduced the general form of the giant extinct New Zealand bird *Dinornis* from just "a six inch splint of bone with broken extremities" (Desmond 1975:101).

Not all such palaeontological endeavours were so compelling however. When Cuvier was shown a tooth of the ornithischian dinosaur *Iguanodon*, he identified

the fossil as the upper incisor of a rhinoceros and later dismissed the metacarpal bones of the same animal as a species of hippopotamus (Delair and Sarjeant 1975). Owen's work on *Iguanodon* was equally flawed. After being called on to supervise the sculpting of a life-size statue of the dinosaur, for the 1851 Great Exhibition of London, Owen not only posed the bipedal *Iguanodon* on all fours, but also placed its characteristic thumb spike on its nose (Desmond 1975).

Although Cuvier was able to acknowledge his errors in identification before Mantell (1825) formally described *Iguanodon*, Owen was not so fortunate. His anatomical *faux pas* were, and remain, highly visible thanks to the continued presence of the giant *Iguanodon* statue on its artificial island at Sydneham in London (Desmond 1975). In fact, almost a century and a half after its unveiling, Owen is still belittled over the anatomical inaccuracies of this reconstruction (Rudwick 1992) even though Owen was neither the first to reconstruct *Iguanodon* nor the first to incorporate such inaccuracies. Around 1835, for example, Mantell first visualized *Iguanodon* as a type of a hypertrophied iguana (Williams 1991). Three years later, two further *Iguanodon* reconstructions were published in popular books on geology. George Nibbs completed a reconstruction as the frontispiece of George Richardson's 1838 book, 'Sketches in Prose and Verse' while John Martin composed a gothic

RECONSTRUCTING *PALORCHESTES*

scene featuring three *Iguanodon* battling each other for Mantell's, 1838 'Wonders of Geology' (Rudwick 1992). Although significantly different from Mantell's original iguana-like reconstruction, both followed his lead by picturing *Iguanodon* as a sprawling reptile with its thumb spike on its nose.

While a paucity of fossil material has historically often been given as the reason for such errors in early reconstructions — in *Iguanodon*'s case nothing more than a "few teeth and isolated bones" (Rudwick 1992:222) — other factors have also been implicated. At the time of *Iguanodon*'s discovery, the very concept of 'dinosaur' had not been formulated and the notion of extinct giant land reptiles was still novel (Delair and Sarjeant 1975:14). Further, given that there was also no demonstrated stratigraphic evidence that the *Iguanodon* fossils were anything older than Quaternary, it is perhaps not surprising that they were, at first, considered to be those of extinct mammals (Delair and Sarjeant 1975). Eventually, the existence of such giant land reptiles came to be accepted by scientists and even enshrined in the appellation *Megalosaurus* or 'great lizard' — the formal name for the first of these creatures to be described (Buckland, 1824). As these giants had no living counterparts, they were understood using modern lizards as analogues and hence reconstructed as quadrupeds (Williams 1991). The first bipedal dinosaurs were not to be discovered for almost another two decades and on a different continent (Leidy 1858). As for the misplaced thumb spike, Mantell had originally indicated that the bone may be a dermal horn or tubercle but was convinced by unnamed authorities that the bone was a lesser horn of a rhinoceros (Delair and Sarjeant 1975). Even when *Iguanodon* was shown to be a giant reptile, it made more sense to place this 'horn' on the nose rather than on the hand given that there were no examples of similar thumb spikes in extant lizards.

Desmond (1979, 1982), however, posits a deeper, political and perhaps even personal motives for Owen's Crystal Palace reconstruction of *Iguanodon* and the establishment of the taxonomic rank of Dinosauria (Owen (1841[1842])). This was to directly challenge the doctrine of Lamarckian transmutation, being espoused by many continental scientists and in England by his *bête noir*, Robert Grant of University College, London. Instead of giving the Crystal Palace statue the typical sprawling posture of all previous reconstructions, Owen stood his *Iguanodon* erect like a mammal (Desmond 1982). By reconstructing it with such a modern stance, Owen hoped to discredit the doctrine of transmutation showing that present-day lizards and snakes represented a *descent* rather than an ascent as the ladder-like progression of the

Lamarckian scheme demanded. Rupke (1994:133), however, contends that the establishment of the Dinosauria was nothing more than "the product of contemporary advances in taxonomic practices".

In Australia, the fossils of extinct giant marsupials, not dinosaurs, were the first to be studied and later reconstructed — primarily by overseas experts (Rich et al. 1985, Vickers-Rich and Archbold 1991). Among the earliest was *Palorchestes*, described by Owen (1873:387) as "the largest form of kangaroo hitherto found". Its reconstructed skull was illustrated by Owen (1876) and then again in his seminal two volume work on Australian fossil mammals. In that work, Owen (1877) also provided a reconstruction of the country's largest marsupial *Diprotodon*. As its feet were unknown at the time, the wily professor disguised these missing elements by hiding them in long grass. The foot bones were eventually found and described, almost a quarter of a century later, by Stirling and Zietz (1900). Modern reconstructions of *Diprotodon* differ little from the initial attempt by Owen except, of course, for the addition of the absent feet (Berganini 1964, Ruhen 1976, Quirk and Archer 1983).

Other diprotodontid reconstructions have not been so readily accepted. The lack of recognizable postcranials of *Zygomaturus* meant that Gerard Krefft's illustration of the animal, reproduced in Whitley (1966), was regarded as "curious speculation" by Archer (1984:677) while Lord and Scott's (1924) reconstruction of the same animal was characterized as a "murky misconception" by Murray (1978:77), in spite of it being based on relatively complete fossil material (Scott 1915). The diprotodontoid *Palorchestes*, whilst being one of the first marsupials to be reconstructed, has also had the most varied reconstructions, being variously envisioned as a giant kangaroo (Owen 1876, Fletcher 1945); a gracile llama-like form (Bartholomai 1978); a bizarre okapian (Ford 1982); an elephantine-trunked quadruped (Flannery and Archer 1985); to its most recent guise as a marsupial 'tapir' (Quirk and Archer 1983) or ground-sloth-like creature (Long et al. 2003).

Changes to how an animal has been reconstructed over time have normally been explained by reference to an increase in the availability of fossil material — "scientists of later periods have the benefit of more (and often better) specimens . . . than were available to their predecessors" (Rudwick 1992:220). The fossils of *Palorchestes*, however, are regarded as uncommon (Mackness 1995:606) or rare elements of fossil assemblages (Murray 1991:1106, Black 1997a:183), perhaps representing a solitary habit (Flannery 1983,

Flannery and Archer 1985, Black and Mackness 1999). The hypothesis that the extraordinary divergence in how *Palorchestes* has been reconstructed is due solely to changes in the amount of fossil material available has never been tested. Nor does such a suggestion allow for the influence of other factors even though these have been shown to have directly affected the visualization of other animals (Desmond 1979, Bakker 1988, Gould 1991, van Reybrouck 1998).

This paper therefore seeks to systematically examine the major reconstructions of the marsupial ‘tapir’ *Palorchestes*, executed over the past 130 years, against the corresponding taxonomic understanding and available fossil material of the time in order to test the notion that changes in reconstructions of a particular animal result solely from improved fossil material and phylogenetic understanding and are independent of all other factor/s. The role played by palaeontological reconstructions in science communications is also discussed.

MATERIALS AND METHODS

Published reconstructions of *Palorchestes* from scientific and popular texts were digitally scanned and their main features rendered into line drawings. The taxonomic history of *Palorchestes* was chronologically arranged using summaries provided by Mahoney and Ride (1975) and Rich (1991). Details of fossils elements described were likewise listed in order of their publication following Woods (1958) and Rich et al. (1991), including those misidentifications that were used in the description of anatomical features of *Palorchestes*. Both these factors were compared against the line drawings of *Palorchestes* in order to ascertain whether there was any correlation between them. The possible effects of broader social and historical issues on each reconstruction were also considered.

RESULTS

Owen (1873) erected the genus *Palorchestes* on the basis of the anterior portion of a cranium, which included the rostrum. The holotype, collected by Dr Ludwig Becker from an unspecified deposit in Victoria, was named *P. azael* Owen, 1873. This locality has since been interpreted by Mahoney and Ride (1975) as the River Tambo in Gippsland. Owen assumed the animal was some sort of giant kangaroo as its cheek-teeth had longitudinal links between and in front of the transverse lophes (Archer 1984). These

features were later shown to have independently evolved in both palorchestids and kangaroos (Woods 1958). Nevertheless, Owen was convinced at the time that the new animal was a macropodid, a view reflected in his choice of its generic name, a conjunction of two Greek words which literally translate as ‘ancient leaper’ (Owen 1874:797).

Two years later, Owen (1876) assigned further elements to *P. azael* including a left and right mandibular rami, sacrum, caudal vertebra, innominate bone, femur, tibia, calcaneum and metatarsals, even though there was no field association with the holotype (Woods 1958). This same paper also contained the first published attempt to reconstruct *Palorchestes* in the form of an outline of its skull (Owen 1876, plate 20). The drawing (Fig. 1a), incorporated a realistic rendering of the holotype with a significant amount of the skull being inferred from extant kangaroos. This included the posterior portion of the cranium and the dentary. Surprisingly, although two mandibular fragments were assigned to *Palorchestes* in the same paper, they were not figured as part of the reconstruction but were used to justify the shape of the jaw as being most similar to *Macropus*, based on the changes in the depth of the fossil rami, rather than other extinct kangaroos such as *Sthenurus* and *Protemnodon* (Owen 1876). By reconstructing *Palorchestes* as a macropodid, Owen effectively obfuscated those features that would eventually come to be recognized as unique to palorchestids, such as the reduction of the nasals.

Owen (1880a) described another species, *P. crassus* from fluviatile deposits near Gowrie, south-east Queensland, on the basis of the symphyseal portion of a mandible with an anomalous condition in the molars of the right ramus. Lydekker (1887), however, found the condition absent in the left ramus and therefore synonymized *P. crassus* with *P. azael*. Woods (1958:182), in supporting Lydekker’s (1887) synonymy, further noted that the distortion originally described by Owen (1880a) was actually “postmortem fracturing, expansion and cementation with matrix”. A palorchestid palate from the Wellington Caves, New South Wales, named *P. rephaim* by Ramsay (1885), was subsequently listed by both De Vis (1895) and Woods (1958) as *P. azael*. Consequently, the second valid palorchestid species to be described was *P. parvus* De Vis, 1895 from south-east Queensland. This new taxon appeared in De Vis’s (1895) paper on fossil macropodid jaws leaving no doubt that he shared Owen’s opinion that palorchestids were kangaroos. A premolar from Beaumaris Victoria identified by Hall and Pritchard (1897) as *Palorchestes* was later shown to belong to the Diprotodontidae (Stirton 1957).

RECONSTRUCTING *PALORCHESTES*

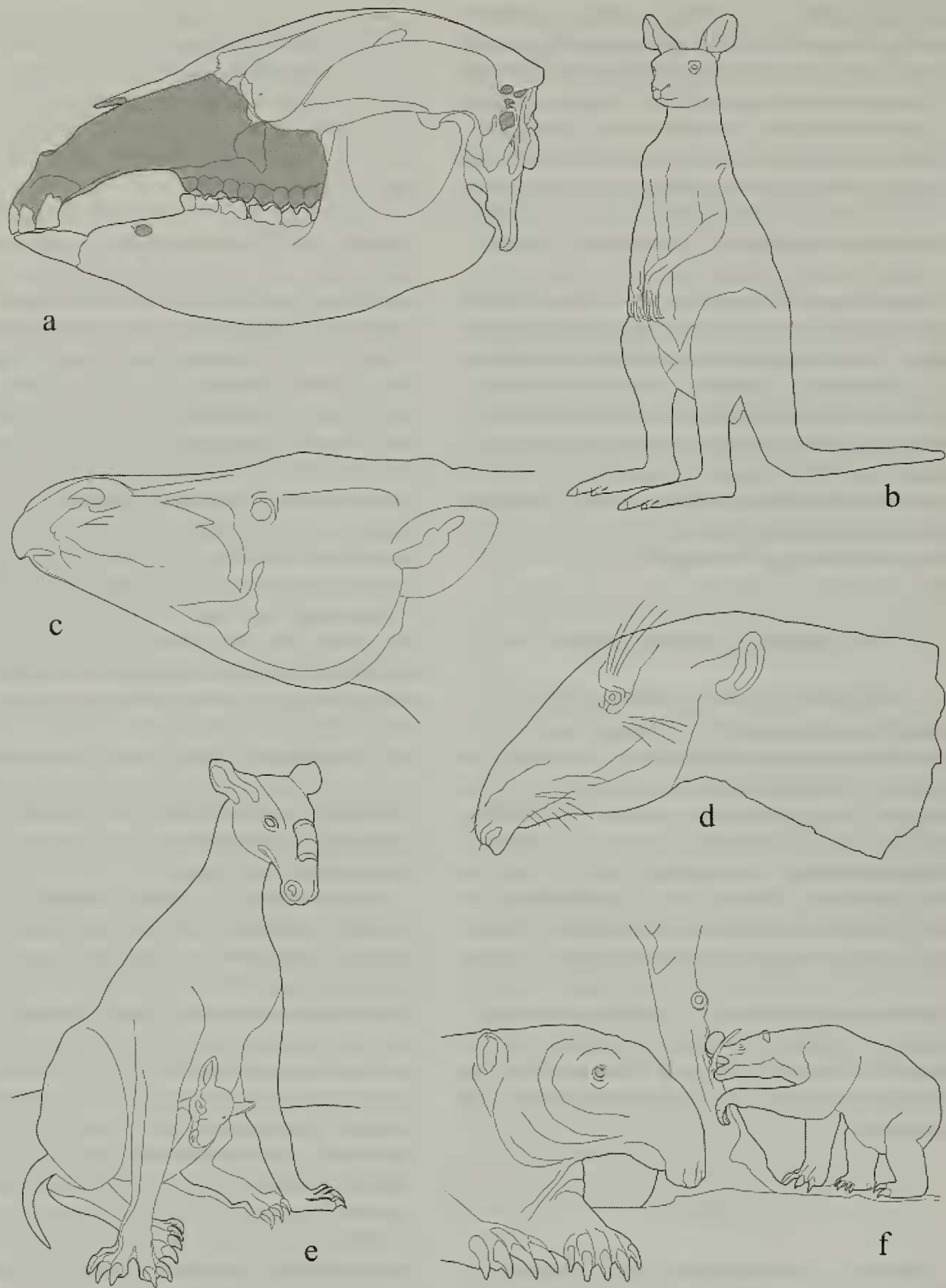


Figure 1. Historical reconstructions of *Palorchestes* from: a. Owen (1876); b. Fletcher (1945); c. Murray (1978); d. Bartholomai (1978); e. Ford (1982); f. Quirk and Archer (1983).

In 1912, the Trustees of the Australian Museum attempted the first three-dimensional reconstruction of *Palorchestes* using measurements from Owen and those from the mounted skins of living kangaroos (Fletcher 1945). The resulting sculpture stood almost three metres in height, even when posed in a resting position. Its imposing stature, when compared to that of living kangaroos, was said to have garnered much attention. This reconstruction was on display in the Museum for thirty-three years (Fletcher 1945).

During the post-war years, the higher classification of some mammal groups, including palorchestids, was reviewed by several workers. Simpson (1945) placed *Palorchestes* within the subfamily Macropodinae, following Owen's lead, but the following year, Raven and Gregory (1946) moved it to the subfamily Sthenurinae. When Tate (1948) revised the kangaroos, he erected a new subfamily, the Palorchestinae, for *Palorchestes*. This meant that when the Australian Museum undertook a second supposedly more realistic reconstruction, taking into account "additional and important fossil remains" and to adopt "less misleading" assessments of how the animal should be modeled, *Palorchestes* was still thought of as a giant kangaroo (Fletcher 1945:363). The resultant model (Fig. 1b), was around 25% smaller than the 1912 original and photographed as the frontispiece of the Australian Museum Magazine (Fletcher 1945).

Claims that this new museum model was the most accurate possible were somewhat tarnished however by errors in Fletcher's (1945) accompanying text. He stated, for example, that *Palorchestes* was "first described in 1877 by Professor Sir Richard Owen, M.D., from the forepart of a cranium and portions of the jaw-bone with teeth" (Fletcher 1945:362-363) not in 1873 and based solely on a partial cranium as accepted by most other workers (Mahoney and Ride 1975, Mackness 1995, Black 1997a). Further, he interpreted the generic name *Palorchestes* to mean "the ancient dancer" (Fletcher 1945:362), even though Owen (1874a:797) specifically detailed its etymology. The greatest inaccuracies in the model, however, were to be exposed some thirteen years later. These were so significant that an embarrassed Australian Museum was forced to make a hasty and unceremonial disposal of their prized reconstruction (Archer 1984) with rumours still persisting that it is actually buried somewhere under Centennial Park in Sydney (M. Archer pers. comm.).

The catalyst for the Museum's precipitous action was a revision of *Palorchestes* by Woods (1958) who proposed that palorchestids were actually closer to diprotodontids than macropodids. The dentary of all

kangaroos possess a large mandibular foramen and masseteric canal. Both of these features were absent or suppressed in *Palorchestes* (Archer 1984). This meant that all the kangaroo-based reconstructions were incorrect and that palorchestids were most probably quadrupedal like other diprotodontids. Further, postcranials that had been attributed to *Palorchestes* in the past (e.g. Owen 1876, Gregory 1902, Scott 1916, Fletcher 1945) were shown by Woods (1958) to belong to either extinct kangaroos or wombats.

The first undisputed palorchestid postcranial material was a series of caudal vertebrae of *P. azael* described by Bartholomai (1962), not in 1975 as claimed by Murray (1978). Five years after their description, a third palorchestid species, *P. painei* Woodburne, 1967, was named from the Miocene Alcoota fauna of central Australia. Significantly, it showed the same extensive modifications to the rostral area that had been observed in *P. azael* and *P. parvus* by Woods (1958). In that same year, Stirton (1967) also formally recognized the Palorchestinae, which included *Ngapakaldia* and *Pitikantia*, as a subfamily within the Diprotodontidae. Archer and Bartholomai (1978) later raised this to familial status — the Palorchestidae.

Further palorchestid postcranials were discovered in the seventies from a cave in the Wee Jasper area of New South Wales (Flannery and Archer 1985). These included a humerus and hindfoot which was subsequently prepared by the Australian Museum (Wells 1978). A humerus of *P. azael* was also reported from Victoria Cave, Naracoorte, South Australia by Wells (1975, 1978) along with phalanges and strange laterally-compressed scimitar-like claws, which Tedford of the American Museum of Natural History opined as being reminiscent of the extinct chalicotheres of the American Miocene. This led Wells (1978:109) to posit a tentative reconstruction of *Palorchestes* as "a large, quadrupedal grazing animal with longish limbs and plantigrade feet".

In the same year that Wells made his textual reconstruction, two new visual attempts were also published (Bartholomai 1978, Murray 1978). Both took account of Woods's (1958) new phylogenetic understanding of palorchestids rejecting the earlier macropodid-based reconstructions. Murray's (1978) sketch of a generalised *Palorchestes* (Fig. 1c), published in the specialist archaeological journal 'The Artefact', was based on the smaller Plio-Pleistocene palorchestid *P. parvus*. The reconstruction was part of a broader attempt to provide images of late Pleistocene fossil marsupials and a monotreme. Murray's (1978, Fig. 12) sketch only included the head and shoulder

RECONSTRUCTING *PALORCHESTES*

region, but a partial view of the entire animal was provided as part of a gallery of reconstructions (Murray 1978, Fig. 17). Following Woods's (1958) re-description of *P. parvus*, Murray (1978:88) posited that *Palorchestes* would have had a "mobile upper lip indicated by the prominent pre-maxillary flange in the skull of *P. parvus*". It appears that Murray (1978:88) was also familiar with Fletcher's (1945) article on the second model made by the Australian Museum as he repeated its error of interpreting the generic name of *Palorchestes* to mean 'graceful dancer'.

By contrast, Oakden's scrapper board drawing of *Palorchestes* (Fig. 1d), for Bartholomai's (1978) paper, was based primarily on the Miocene species *P. painei*. The catalyst for this reconstruction was the description of the cranium of *P. painei* by Woodburne (1967); the preparation of further cranial material of the same species collected from the Waite formation during the 1974 Ray E. Lemley expedition of the Queensland Museum; and similar but less complete material of *P. azael* and *P. parvus* held in the Queensland Museum (Bartholomai 1978:145). The reduction of the nasals, the elongation of the anterior of the palate and the presence of very large infraorbital foramina observed in these specimens led Bartholomai (1978) to postulate that all known species of *Palorchestes* probably had an extensive rhinarium or a tapir-like proboscis. Further, Bartholomai (1978) interpreted the narrow, deeply channeled mandibular symphysis as indicative of *Palorchestes* having had a long, flexible tongue.

There were differences between the two reconstructions of *Palorchestes*, however, that could not be explained simply by the fact that they were based on different species. While Murray (1978:88) characterized *Palorchestes* as a 'lightly built diprotodontid', Bartholomai (1978) reconstruction was even more gracile with the longer neck making the animal look very llama-like. The position of the nares also differed, with those of Murray (1978) placed more posterior and superior to those in Bartholomai (1978). The latter was in line with Bartholomai's (1978:148) assertion that *Palorchestes* may have possessed an "extensive rhinarium with anterodorsally directed nostrils". Bartholomai's (1978) *Palorchestes* was the first to feature a tapir-like trunk and also featured conspicuous vibrissae on the snout.

By 1980, confirmation that the Wee Jasper material was indeed palorchestid came when a partial skeleton in the collection of the National Museum of Victoria was also shown to be that of *Palorchestes* (Flannery and Archer 1985). Although the Museum skeleton had no locality data, its association with some undisputed palorchestid teeth made the

specimen very important. Several of the bones in the skeleton had previously been labeled incorrectly by Scott (1916) as a giant species of wombat or wombat-like animal. Subsequently, other bones from Foul Air Cave at Buchan in eastern Victoria were also recognized as palorchestid. Given that the humerus of the Wee Jasper specimen was much smaller than the Buchan material, it was assumed that the Wee Jasper fossils represented *P. parvus* while the Buchan bones were those of the larger *P. azael* (Flannery and Archer 1985).

The identification of this additional postcranial material enabled a full reconstruction of *Palorchestes* as a quadruped. In 1981, Stahel produced a stipple drawing of an entire animal for an article published in a University newsletter (Archer 1981). This illustration was used the following year as the basis of a reconstruction (Fig. 1e) by Ibrahim for an article in the science magazine 'Omega Science Digest' titled 'The strange creatures of ancient Australia' (Ford 1982). What is significant about both drawings is that they embodied a rather 'chimeric' understanding of *Palorchestes*, demonstrating a concomitant "high coefficient of weirdity" (Archer 1984:670). The overall body outline was rather 'okapi-like' with the hind-quarters lower than the front and the neck long and giraffid-like. The 'bizarre herbivorous animal' was said to be as "large as a horse . . . [with] a trunk-like structure on its face . . . kangaroo-like teeth . . . [a] long giraffe-like tongue and . . . phenomenally huge sharp claws" (Ford 1982:84-85). These sharp koala-like claws were even thought, for a brief time, to represent an adaptation to climbing in trees like modern-day sloths but the idea was rejected when the huge size of *Palorchestes* became apparent (Archer 1984:670). These speculative views of *Palorchestes* were informed by palaeontologist Mike Archer who, just one year later, was involved in the production of another reconstruction that directly challenged many of the assumptions inherent in the 'okapi-like' model (Archer 1984).

The rethink of how *Palorchestes* should be reconstructed was prompted by several factors including the identification of additional fossil elements and the opportunity to further refine or challenge aspects of previous reconstructions. The neck length of the Stahel and Ibrahim reconstructions, for example, was deemed too long after the discovery that palorchestid cervical vertebrae were not elongate like that of giraffids (Archer 1984:670). Likewise, the size of the trunk was also thought to be over-inflated and consequently reduced with the tail likewise being shortened. These changes were encapsulated in a new rendering of *Palorchestes* which Archer (1984:670)

judged to be the “best” to date, acknowledging however that his opinion was biased, given his involvement in its formulation. The reconstruction, executed by Schouten (Fig. 1f), appeared in a book on prehistoric animals published by the Australian Museum (Quirk and Archer 1983). Schouten presented a composite view of the head and front feet of *P. azael* along with a full-view of the animal ripping bark from a tree. Beneath this illustration, a further sketch was provided to demonstrate how *Palorchestes* may have used its tongue to strip vegetation off branches. The body shape of Schouten’s *Palorchestes* was much more diprotodontid-like and its size more like that of a bull. The reconstruction also highlighted *Palorchestes*’s massive forearms; its rapier-like claws and tapir-like trunk. The text accompanying the new reconstruction was titled “unique trunked giant” and contained the first explicit connection between *Palorchestes* and Aboriginal people. Flannery (1983:54), who penned the text, suggested that *Palorchestes* may have been the inspiration behind the legend of the bunyip and that newly arrived Aboriginals may have had second thoughts about settling after seeing one of these giant marsupials. Further, Flannery (1983:54) claimed that Aboriginal people and *Palorchestes* had “co-existed in Australia between about 40 000-20 000 years ago”.

In 1984, three different reconstructions of *Palorchestes* were executed by Murray, but in very different contexts. The first was a drawing of a generalized palorchestid (Fig. 2a) as part of a family tree of diprotodontoids presented in a children’s book ‘Australia’s prehistoric animals’ (Murray 1984a). Both *Palorchestes* and the mid-Miocene *Ngapakaldia* were shown on the same blue branch representing the Palorchestidae (Murray 1984a). In contrast to his 1978 reconstruction of *Palorchestes* (Fig. 1c), however, Murray’s new depiction had a much longer tapir-like trunk. This interpretation was justified with the inclusion of a diagram showing the similarities between the skull and trunk of a tapir and that suggested for *Palorchestes*. Murray’s illustration differed from Schouten’s (Fig. 1f) in having a longer tail but smaller body. Murray was also the first to explicitly use the term “tapir-like marsupial” (Murray 1984a:20).

Murray’s second reconstruction was specifically of *P. azael* (Fig. 2b) and was published in a book on Quaternary extinctions. As with Ford’s (1982) characterization, *Palorchestes* was once again presented as a composite animal only this time it was said to have “tapir, chalicotheres, pantodont and sloth-like features” (Murray 1984b:608). The “large kangaroo-like tail” of *P. azael* was highlighted, citing

Bartholomai (1962) and a personal communication from the same author, while Archer and Bartholomai (1978) were quoted as the source of *P. azael* being “equipped with huge, curved, laterally compressed claws” (Murray 1984b:608). The overall body size of Murray’s *P. azael* was much more massive than his more generalized drawing (Fig. 2a) and featured a long flexible tongue. Fossil remains of *P. azael* were regarded by Murray (1984b) as not especially common but widely distributed, with specimens of *P. azael* from Pulbeena Swamp in Tasmania, (54 200+11 000 - 4 500 yr BP) listed as a recent occurrence of the taxon (Banks et al. 1976).

Flannery’s (1983) suggestion that *Palorchestes* and Aboriginal people lived contemporaneously was seemingly validated in 1984 when a large Aboriginal painting (Fig. 2c) was tentatively identified as a possible representation of the extinct marsupial (Murray and Chaloupka 1984). The painting, discovered in Deaf Adder Gorge, Arnhem Land in 1976, was part of a tradition called the Large Naturalistic Animal Style (sensu Chaloupka 1993), which included depictions of animals now extinct from the Australian mainland such as thylacines and Tasmanian devils (Calaby and Lewis 1977, Lewis 1977, Clegg 1978). Some of the features used by Murray and Chaloupka (1984) to identify the painting as *Palorchestes* included: 1) the considerable attention given to the tongue including small lines which were said to perhaps represent items of food such as leaves or insects; 2) the detail given to the claws and the angled calcaneal joint; and 3) a lack of ears. Two anomalous breast-like projections under the body were explained as “stylised attempts to show a long shoulder mane or shaggy long hair” (Murray and Chaloupka 1984:114). A smaller animal besides the larger painting was said to represent a joey of the extinct marsupial. Murray and Chaloupka (1984) compared the *Palorchestes* painting with those of introduced animals such as those found previously in Cape York (Trezise 1971) as well as a variety of megafaunal species.

In suggesting that the painting represented a *Palorchestes*, Murray and Chaloupka (1984:115) were extremely circumspect however, stating that “maybe it [the painting] represents *Palorchestes*” but “it must be made very clear that the connection at present is of the most tenuous kind”. They even suggested that “there may not be much gained by attempting to compare this unique and intriguing painting with perhaps the most poorly known species in the megafaunal assemblages” (Murray and Chaloupka 1984:112). In spite of such tentativeness, however, and in spite of a serious challenge to both the methodology and assumptions used (Lewis

RECONSTRUCTING *PALORCHESTES*

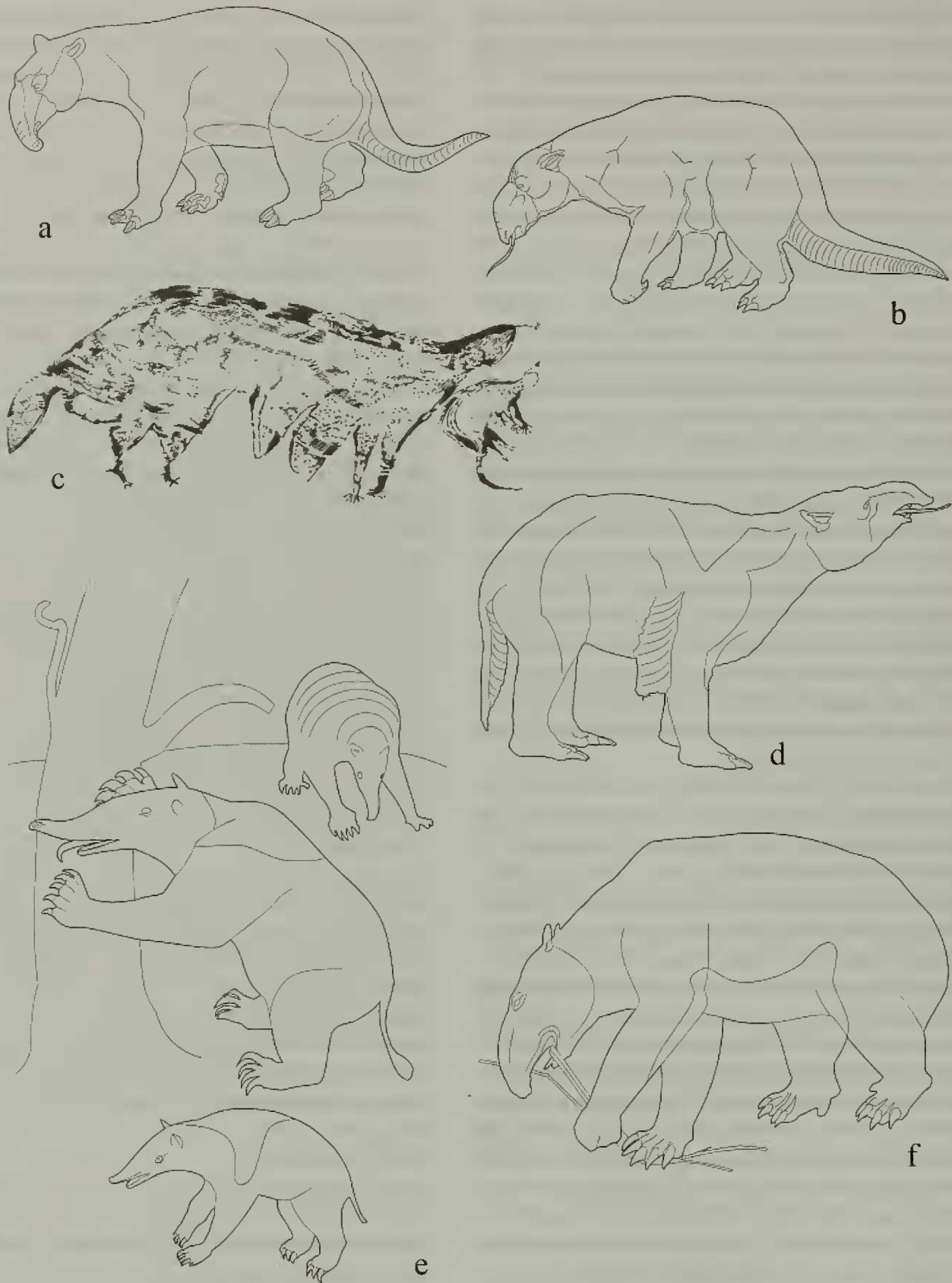


Figure 2. Further reconstructions of *Palorchestes* from: a. Murray 1984a; b. Murray 1984b; c. Arnhem Land 'Palorchestes' from Murray and Chaloupka (1984); d. Murray and Chaloupka (1984); e. Rich et al. (1985), f. Long et al. (2003).

1986, Mackness, unpublished data), the painting has been promoted as a credible example of megafauna depiction by Aboriginal artists (Chaloupka 1993, Flood 1997).

A third *Palorchestes* reconstruction (Fig. 2d) by Murray appeared in his joint paper with Chaloupka on rock art. What was unique about the reconstruction was that certain features were specifically added to match the supposed Aboriginal representation of *Palorchestes*. The most obvious of these was a mane of long hair protruding below the line of the abdomen to match the anomalous projections of the painting (Murray and Chaloupka 1984). This feature was not present in any of Murray's previous 1984 reconstructions. The ears were also placed so that they didn't project beyond the outline of the head to likewise match the painting. In Murray's generalised *Palorchestes* (Fig. 1a), the line of the ears was clearly shown projecting above the head. In support of such modifications, the authors restated Clegg's (1981:313) assertion that "if a well executed drawing of potentially great antiquity best matches a good restoration of an extinct species, then that may well have been the target species". While invoking this "Occam's Razor of rock art analysis" as justification for their identification of a *Thylacoleo* drawing, Murray and Chaloupka (1984:115) regarded the evidence for the *Palorchestes* drawing as being "less satisfactory" however.

While the reconstructions of *Palorchestes* by both Schouten and Murray featured relatively short tapir-like trunks and diprotodontid-like bodies, Knight's (Fig. 2e) composite illustration of *P. azael* and *P. parvus*, published in Rich et al. (1985), featured much longer trunks, body shapes more reminiscent of myrmecophagids and rhinoceros-like tails. Knight actually completed the illustration in 1982, around the same time that the Stahel and Ibrahim reconstructions were published. The text accompanying the illustration, by Flannery and Archer (1985), provided the first detailed description of palorchestid postcranials along with a sketch of the articulated arm bones and a rear view of the humerus.

Flannery and Archer (1985) argued that the front legs of palorchestids were unusual, relative to other marsupials, because of a greatly enlarged area for the attachment of the pectoralis muscle which formed a high, hooked process. The ulna of both species was said to be almost solid with only a tiny marrow cavity. The nature of the articulation between the lower and upper arm bones in *P. azael* was such that it appeared to indicate an immobile elbow with the front legs being permanently locked in a partly flexed

position, strengthening the already massive forearms. The smaller *P. parvus*, however, appeared to have a slightly more flexibility in this joint. The authors also drew attention to the highly mobile fingers that each bore a massive, sharp, laterally-compressed claw similar to that of a koala but far larger. Flannery and Archer (1985) interpreted these claws as suitable for ripping, tearing or climbing but not for digging.

By comparison, the authors considered the hindlimb of *Palorchestes* to be far less robust. The fourth and fifth toes were equipped with the same kind of massive claws seen on the fingers of the hands but toes two and three were reduced in size and syndactylous, perhaps used for grooming. Flannery and Archer (1985) also suggested that *Palorchestes* may have possessed a clawless opposable great toe similar to that seen in possums. Overall they suggested that *Palorchestes* filled a niche similar to that of elephants or the extinct ground sloths of the Americas, using its narrow and elongate tongue in conjunction with its trunk, to strip leaves off trees and bushes. Once again, an explicit connection was made between *Palorchestes* and Aboriginal people with the suggestion that the "exceptionally powerful forearms, massive claws and bizarre head would surely have been enough to have inspired the legend of the bunyip — or at least a few nightmares among Australia's first Aboriginal inhabitants" (Flannery and Archer 1985:236).

The composition of the Palorchestidae was challenged by Murray the following year with the description of the lamb-sized palorchestid *Propalorchestes* from mid-Miocene deposits of Bullock Creek Local Fauna, Northern Territory and several Oligo-Miocene sites at Riversleigh, Queensland. Doubts had previously been cast by Archer and Bartholomai (1978) and Archer (1984) about the monophyly of the Palorchestidae. Aplin and Archer (1987), in their review of marsupial systematics, had placed palorchestids in their present position within the Vombatiformes.

A further reconstruction of *Palorchestes* (Fig. 3) was executed by James Reece for a popular book on prehistoric life by Mackness (1987). Reece combined the reconstructions of Schouten and Knight to produce a hybrid image that adhered to a by now standard formula for illustrating *Palorchestes* with a diprotodontid body, sharp claws and tapir-like trunk. Such visual codification, called conventionalization by Rudwick (1992) enabled those viewing the animal to instantly recognize it as *Palorchestes*.

In 1990, Murray described another species of *Propalorchestes* and concluded that members of that genus were the plesiomorphic sister-taxon of

RECONSTRUCTING *PALORCHESTES*

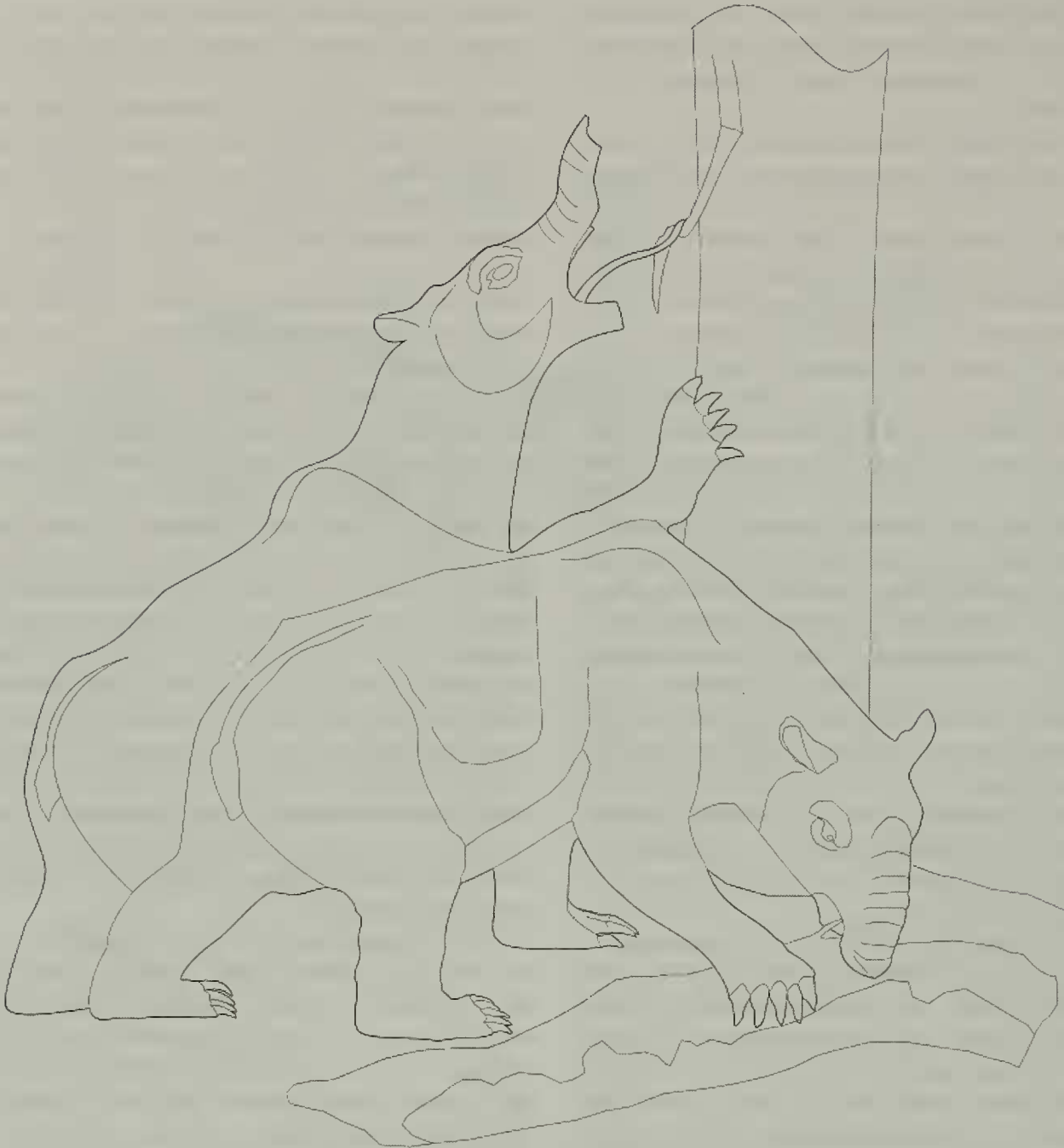


Figure 3. Reconstructions of *Palorchestes* from Mackness (1987).

Palorchestes while *Ngapakaldia* and *Pitikantia* should be regarded as primitive members of the Diprotodontidae (Black 1997a). Five years later, a new species of palorchestid, *Palorchestes selestiae*, was described from the early Pliocene Bluff Downs Local Fauna on the basis on an isolated M¹ (Mackness, 1995) with a fifth species, *P. anulus* described just two years later by Black (1997a) from the early-late Miocene Encore Local Fauna, Riversleigh, again on the basis of an isolated M¹. The most recently described palorchestid, *P. pickeringi*, was recovered by Piper (1996) from Pliocene and early Pleistocene deposits of Victoria. It is represented by a significant

amount of fossil material and has also possibly been identified from Queensland (Hocknull et al. 2007).

By the last decade of the twentieth century, the term “marsupial tapir” had become firmly entrenched as the popular name for palorchestids (Murray 1991) even though alternative descriptors such as “marsupial tree-fellers” had been proposed (Flannery 1994). The visual codification of *Palorchestes* reconstructions continued to be refined with the most recent reconstruction of *P. azael* (Fig. 2f), executed by Anne Musser and published in Long et al. (2003), perhaps being the apogee of how the animal should be depicted. Musser’s illustration did not show an

exaggeratedly long tongue or a trunk capable of being bent back on itself as illustrated by Schouten. The forearms were shown to be immobile following Flannery and Archer (1985), while the tail was more like that proposed by Murray (1984b). The explicit connection between *Palorchestes* and the eutherian *Tapirus* was also being down-played with extinct ground sloths now being the dominant analogue. This suggestion, first raised by Archer (1984) and Murray (1991), was visually encoded by the depiction of *Palorchestes* walking on the sides of its feet or on its knuckles. Long et al. (2003) also included an illustration of the skull of *P. painei* showing its fragmentary nature, linking the real with the inferred in a similar manner to that first employed in Owen's (1876) first reconstruction almost a hundred and thirty years previously.

DISCUSSION

The veracity of palaeontological reconstruction is underpinned by a specific methodology which is supposedly deployed with each attempt to illustrate a prehistoric creature. Murray (1978:77) characterizes "serious" reconstructions as only those that are based on "detailed anatomical build up of soft tissues". This requirement challenges most reconstructions as very few conform to such rigor. Schouten visualized this same process using *Diprotodon* as an example in Quirk and Archer (1983). It should be noted, however, that it would have been singly impossible for any one artist to have the detailed anatomical knowledge required to undertake similar soft tissue build ups of all the other animals illustrated in that work.

Rudwick (1992:221) provided yet another outline of the methodology suggesting it occurs in the following sequence:- 1) the selection of suitable fossil bones for assembly of a partial skeleton of a particular individual; 2) the reconstruction of a complete skeleton representative of the species, based generally on the remains of many individuals; 3) reconstruction of a generalised complete individual body with inferences about the animal's unpreserved muscles and other soft parts, based partly on anatomical analogy with related living forms; 4) and finally inferences about the animal's dynamic mode of life and habits, based partly on functional analysis of its anatomy and on physiological analogy with related living forms. Rudwick (1992:221) posits that the outcome of such a sequence is "a cascade of representations that are progressively bolder—yet still well-founded—reconstructions of the unobservable prehuman past

. . . progressing from the observed to the inferred, from the specific and contingent to the general and idealized". Changes in successive attempts to portray the same animal are simply "attributed to the discovery of more and better specimens that are relevant to that reconstruction" (Rudwick 1992:220).

Latour (1986:17), however, from whom Rudwick (1992) derived the notion of "cascade", uses the term in a much different sense. For Latour (1986:17), the sequence of reconstructing a prehistoric animal results in a "cascade of ever simplified inscriptions [visual representations] that allow harder facts to be produced". Therefore, it is the selection of bones from a collection to be used in the description of a new species or the reconstruction of a complete skeleton from bones held in several museums over a wide geographic locality that allow scientists to make "bolder" reconstructions. When a pile of individual elements are coalesced into a published type description or into an articulated form, they became a single entity of "the type of . . ." or "the skeleton of . . ." with all its associated eidetic qualities. This process of accumulation and simplification is only useful however when there is confidence that the meaning of each coalescence has been stabilized (Pinch 1985). If it hasn't, then all subsequent layers that are built upon it risk collapsing like a veritable 'house of cards' should the underlying assumptions prove to be unstable or incorrect.

Such was the case with Owen's (1876, 1877) reconstruction of *Palorchestes* as a macropodid. While in hindsight, it may seem that Owen made a grave error in his classification of the animal, Fyfe and Law (1988:1) caution that ". . . both the processes that lead to the creation of depictions, and the way in which they are subsequently used, have to be studied in their historical specificity". With *Palorchestes*, several factors mitigated against Owen recognizing its 'true' taxonomic affinities. The partial cranium used as the holotype, for example, lacked those features, such as the reduction and retraction of the nasals, which would eventually be regarded as autapomorphies for palorchestines. Indeed, it wasn't until almost a century later, after Woods (1958) had revised the genus and Woodburne (1967) had described *P. painei*, that suitable material became available to elucidate such characters.

The presence of longitudinal links between and in front of the transverse lophs, while used by Owen (1874) to justify *Palorchestes* as a kangaroo, has since been shown to be convergent with at least two zygomaturine genera — *Maokopia* Flannery, 1992 and a new, as yet unnamed, Plio-Pleistocene species from eastern Australia (Black and Mackness

1999. Mackness, unpublished data) possessing similar links. Flannery (1992:325) postulates that the development of “anteroposteriorly directed linking is an adaptation to a more abrasive diet”. Similarly, it wasn’t until the early part of the twentieth century that Abbie (1939) demonstrated that the presence of the masseteric fossa was a feature that united all macropodids. The fossil rami described by Owen (1876) lacked this relevant portion. Archer (1984) rightly concluded that the absence of such a feature in palorchestids didn’t preclude the possibility that they were still a plesiomorphic sister group of kangaroos. It wasn’t until Murray’s (1986, 1990) description of *Propalorchestes* and detailed biostratigraphical research into the Riversleigh Local Faunas by Black (1997b) that the taxonomy of palorchestids obtained some sort of stability with many authors (e.g. Archer and Bartholomai 1978, Archer 1984, Murray 1990, Mackness 1995) having previously cast doubt about the phylogenetic make-up of the group.

The first major rethink about how *Palorchestes* should be reconstructed was not so much a result of additional and better fossil evidence becoming available as required by Rudwick’s (1992) sequence, but rather a reassessment of existing museum material and a consequential re-interpretation of its phylogenetic affinities (Woods 1958). This conforms to Latour’s (1986) notion of a ‘cascade’ with Wood’s (1958) coalescence providing a stable platform for harder facts to be produced. When new fossil material was collected by Woodburne (1967) and Bartholomai (1978), it was therefore added to the already stable platform of ‘palorchestids as diprotodontoids’. In particular, Bartholomai’s (1978) interpretation that the rostral area of palorchestids may have supported a tapir-like proboscis or extensive rhinarium provided the basis for the interpretation of palorchestids as marsupial ‘tapirs’. The lack of unequivocal palorchestid postcranials, however, apart from those described by Bartholomai (1962), meant that only the head region was known well enough for Bartholomai (1978) and Murray (1978) to attempt reconstructions — except for one very generalized body view (Murray’s 1978, Fig. 17). Even after palorchestid postcranials had been discovered and identified from caves in New South Wales, Victoria and South Australia in the 1970’s, their lack of publication meant they were effectively unavailable for use in reconstructions except for those few who had access to the relevant museum collections and the detailed anatomical knowledge to interpret what individual elements represented. To this day, the only description of these fossils is the popular account by Flannery and Archer (1985) in Rich et al. (1995).

The temporal lag of almost a decade between the discovery of these fossils and their incorporation into reconstructions also suggests that the relationship proposed by Rudwick (1992) may not be as straight forward as first thought. While some delay is to be expected, to allow for the preparation, study and publication of fossils, the postcranials of *Palorchestes* were never published in a peer-reviewed journal. Further, the most diverse representations of *Palorchestes* occurred between 1981 and 1983 (acknowledging that Knight’s reconstruction was completed in 1982) after the concept of palorchestids as diprotodontoids was stabilized by Woods (1958). The various attempts at reconstruction may, in part, be due to scientists using them as heuristic devices to test various anatomical options. The fact that palaeontologists Archer and Flannery, supervised all these divergent ‘views’ of *Palorchestes* perhaps bears this out.

Van Reybrouck (1998), in his study of Neanderthal reconstructions, suggests that the intellectual *zeitgeist* may also affect how an organism is visualized. The publication of the various reconstructions of *Palorchestes* coincided with what Tedford (1991:76) characterizes as the “coming of age” of Australian vertebrate palaeontology with many academic institutions launching indigenous study programs at that time. Concomitantly, it was also a time when attempts were being made to raise the profile of the discipline in order to attract new students to the nascent palaeontological programs being offered at Universities (Vickers-Rich and Archbold 1991, Tedford 1991); to raise funds for research; and to mobilize and educate the general public (Quirk and Archer 1983, Rich et al. 1985, Mackness 1987). Perhaps not surprisingly, these popular texts featured creatures with superlative values such as the oldest, the largest or in *Palorchestes*’s case, the weirdest (Archer 1984:670). Part of the reason *Palorchestes* came to be reconstructed in so many guises was its ‘weirdness’ when compared to other marsupials.

As well as being co-opted as a ‘poster child’ to demonstrate the uniqueness of Australia’s past, *Palorchestes* was included in some seminal debates about Aboriginality concerning the interrelated topics of land rights, environmental management and the extinction of the megafauna. Questions about the antiquity of Aboriginal settlement of the Australian continent had followed the widespread availability of radiocarbon dates (Mulvaney and Kamminga 1999) and in particular the dating of the Lake Mungo burials. A date of more than 40 000 years became a “slogan for indigenous people” (Gillespie 2004:1) and mobilized in legal arguments about rights to land (Yunupingu

1997). The contemporaneity of Aboriginal people and extinct megafauna was another plank in this argument with suggestions that *Palorchestes* was the subject of the bunyip legend (Flannery 1983, Flannery and Archer 1985) and its supposed representations in rock art (Murray and Chaloupka 1984) adding credence to such claims. While Owen (1880b) was amongst the first to implicate Aboriginal people and the extirpation of the Australian megafauna, the early eighties saw the emergence of a full blown debate on the issue (Horton 1979, 1980; Martin and Klein 1984), a subject that continues to provoke controversy two decades later (Flannery 1994, Horton 2000, Roberts et al. 2001, Wroe et al. 2004).

Consequently, while fossil discoveries and reinterpretations of phylogenetic relationships have played an important part in the varied reconstructions of *Palorchestes*, other broader factors have also been implicated. No matter what these influences are, however, they only become relevant if a particular reconstruction continues to be deployed. Corrigan (1988) contends that every time someone reproduces a reconstruction it becomes imbued with power. The context of reproduction can also play an important part in how a reconstruction is judged. Schouten's 1983 reconstruction of *Palorchestes azael* has, until recently, held sway not only because it supposedly best matched the fossil evidence and was the most sophisticated rendition (Archer 1984) but also because it appeared in a book published under the imprimatur of the Australian Museum, one of the nations leading scientific institutions. The most recent reconstruction by Musser in Long et al. (2003) has yet to gain the same widespread exposure of Schouten's effort but it obviously has only been in circulation for a short time. Its eventual hegemony also rests on the acceptance of the ground sloth analogy, explicit in the reconstruction rather than the existing and long-standing marsupial 'tapir' model.

Latour (1987:258) suggests that '...to determine the objectivity or subjectivity of a claim [like that made by a scientific illustration] . . . we look not for their intrinsic qualities but all the transformations they undergo later in the hands of others'. Consequently, future reconstructions of *Palorchestes* will not just be judged by whether or not they best fit the palaeontological information available but also whether they are reproduced in wide enough contexts to be accepted.

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RECONSTRUCTING *PALORCHESTES*

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